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EOSDIS Core System Project

ECS Training Material Volume 5: Network Administration

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RESPONSIBLE ENGINEER

Kenneth Prickett Date
EOSDIS Core System Project

SUBMITTED BY

Gary Sloan, M&O Manager Date
EOSDIS Core System Project

Raytheon Company
Upper Marlboro, Maryland

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Preface

This document is a contract deliverable with an approval code of 3. As such, it does not require formal Government approval. This document is delivered for information only, but is subject to approval as meeting contractual requirements.

Any questions should be addressed to:

Data Management Office
The ECS Project Office
Raytheon Company
1616 McCormick Dr.
Upper Marlboro, MD 20774-5301

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Abstract

This is Volume 5 of a series of lessons containing the training material for Release 6B of the Earth Observing System Data and Information System (EOSDIS) Core System (ECS). This lesson provides a detailed description of the process required to perform the tasks associated with network administration.

***Keywords**:* training, course objective, network administration

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Introduction

Identification

Training Material Volume 5 is part of Contract Data Requirements List (CDRL) Item 129, whose requirements are specified in Data Item Description (DID) 625/OP3, and is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000).

Scope

Training Material Volume 5 describes the process and procedures associated with Network Administration. It describes ECS network topology, connectivity, and security. In addition, it addresses the use of network monitoring tools. This lesson is designed to provide the operations staff with sufficient knowledge and information to satisfy all lesson objectives.

Purpose

The purpose of this Student Guide is to provide a detailed course of instruction that forms the basis for understanding network administration in the context of the ECS configuration. Lesson objectives are developed and will be used to guide the flow of instruction for this lesson. The lesson objectives will serve as the basis for verifying that all lesson topics are contained within this Student Guide and slide presentation material.

Status and Schedule

This lesson module provides detailed information about training for Release 6B. Subsequent revisions will be submitted as needed.

Organization

This document is organized as follows:

Introduction: The Introduction presents the document identification, scope, purpose, and organization.

Related Documentation: Related Documentation identifies parent, applicable and information documents associated with this document.

Student Guide: The Student Guide identifies the core elements of this lesson. All Lesson Objectives and associated topics are included.

Slide Presentation: Slide Presentation is reserved for all slides used by the instructor during the presentation of this lesson.

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Related Documentation

Parent Document

The parent document is the document from which this ECS Training Material's scope and content are derived.

423-41-01	Goddard Space Flight Center, EOSDIS Core System (ECS) Statement of Work

Applicable Documents

The following documents are referenced within this ECS Training Material, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document:

420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System (ECS)
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System (ECS)

Information Documents

Information Documents Referenced

The following documents are referenced herein and amplify or clarify the information presented in this document. These documents are not binding on the content of the ECS Training Material.

609-CD-610	Release 6B Operations Tools Manual for the ECS Project
611-CD-610	Mission Operation Procedures for the ECS Project
910-TDA-022	Custom Code Configuration Parameters for ECS

Information Documents Not Referenced

The following documents, although not referenced herein and/or not directly applicable, do amplify or clarify the information presented in this document. These documents are not binding on the content of the ECS Training Material.

305-CD-610	Release 6B Segment/Design Specification for the ECS Project
311-CD-600	Release 6A Data Management Subsystem Database Design and Database Schema Specifications for the ECS Project

311-CD-601	Release 6A Ingest Database Design and Database Schema Specifications for the ECS Project
311-CD-602	Release 6A Interoperability Subsystem (IOS) Database Design and Database Schema Specifications for the ECS Project
311-CD-603	Release 6A Planning and Data Processing Subsystem Database Design and Schema Specifications for the ECS Project
311-CD-604	Release 6A Science Data Server Database Design and Schema Specifications for the ECS Project
311-CD-605	Release 6A Storage Management and Data Distribution Subsystems Database Design and Database Schema Specifications for the ECS Project
311-CD-606	Release 6A Subscription Server Database Design and Schema Specifications for the ECS Project
311-CD-607	Release 6A Systems Management Subsystem Database Design and Schema Specifications for the ECS Project
311-CD-608	Release 6A Registry Database Design and Schema Specifications for the ECS Project
311-CD-609	Release 6A NameServer Database Design and Schema Specifications for the ECS Project
313-CD-610	Release 6B ECS Internal Interface Control Document for the ECS Project
334-CD-610	6B Science System Release Plan for the ECS Project
601-CD-001	Maintenance and Operations Management Plan for the ECS Project
603-CD-003	ECS Operational Readiness Plan for Release 2.0
604-CD-001	Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-002	Operations Concept for the ECS Project: Part 2B -- ECS Release B
605-CD-002	Release B SDPS/CSMS Operations Scenarios for the ECS Project
607-CD-001	ECS Maintenance and Operations Position Descriptions
152-TP-001	ACRONYMS for the EOSDIS Core System (ECS) Project
152-TP-003	Glossary of Terms for the EOSDIS Core System (ECS) Project
211-TP-007	Transition Plan 6A.04 to 6A.XX (6A.05) for the ECS Project
220-TP-001	Operations Scenarios - ECS Release B.0 Impacts
500-1002	Goddard Space Flight Center, Network and Mission Operations Support (NMOS) Certification Program, 1/90

535-TIP-CPT-001	Goddard Space Flight Center, Mission Operations and Data Systems Directorate (MO&DSD) Technical Information Program Networks Technical Training Facility, Contractor-Provided Training Specification

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Network Administration

Lesson Overview

This lesson will provide you with the tools needed to perform the various tasks required to administer the network management portion of the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) during maintenance and operations. It includes a detailed review of the procedures required to perform network management tasks as outlined below.

Lesson Objectives

Overall Objective - The overall objective of this lesson is proficiency in the basic concepts of network administration and the specific methodology and procedures for managing a site network of the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) during maintenance and operations. The lesson includes a description of the basic network topology, connectivity, and security as a basis for discussion of site-specific network management. In addition, it includes a detailed treatment of the application of the commercial, off-the-shelf (COTS) software used for ECS network monitoring.

Condition - The student will be given a copy of *609-CD-610-002 Release 6B Operations Tools Manual for the ECS Project*, a copy of *611-CD-610-001 Mission Operations Procedures for the ECS Project*, and a access to system management tools in a functioning ECS network.

Standard - The student will use the Procedures Manual in accordance with prescribed methods and complete required procedures without error to accomplish all tasks required.

Specific Objective 1 - The student will be able to identify the major elements of the local network topology.

Condition - The student will be given a copy of *609-CD-610-002 Release 6B Operations Tools Manual for the ECS Project*, a copy of *611-CD-610-001 Mission Operations Procedures for the ECS Project*, and a access to system management tools in a functioning ECS network.

Standard - The student will identify the Production Network, the User Network,, and the HiPPI network without error.

Specific Objective 2 - The student will be able to identify the hardware components of the local network.

Condition - The student will be given a copy of *609-CD-610-002 Release 6B Operations Tools Manual for the ECS Project*, a copy of *611-CD-610-001 Mission Operations Procedures for the ECS Project*, and a access to system management tools in a functioning ECS network.

Standard - The student will identify without error each of the hardware components comprising the local network, to include as appropriate the FDDI concentrator, the Ethernet-to-FDDI hub, the Access server, the ECS router, the Ethernet switch, and the HiPPI switch.

Importance

The Network Administration lesson will provide a review of the process that allows the Maintenance and Operations (M&O) staff responsible for the management of network operations to configure and monitor the hardware and software components of the ECS network.

Network Topology

DAAC LAN Topology Overview

The Distributed Active Archive Center (DAAC) Local Area Network (LAN) consists of a User Fiber Distributed Data Interface (FDDI) Network, a Production/Ingest Ethernet Network, and a High Performance Parallel Interface (HiPPI) Network. Figures 1-4 illustrate overviews of the LAN topology for the EROS Data Center (EDC) DAAC, the National Snow and Ice Data Center (NSIDC) DAAC, the Langley Research Center (LaRC) DAAC, and the Goddard Space Flight Center (GSFC) DAAC.[1] As the figures show, there are variations in the topology at the different sites. Note: The NSIDC DAAC does not have Ingest or HiPPI networks.

The creation of separate User and Processing networks allows processing flows to be unaffected by user pull demands, and the introduction of the high-speed HiPPI Network provides adequate bandwidth to the Processing and Data Server subsystems to transfer high volumes of data. Each of the networks is discussed in detail below.

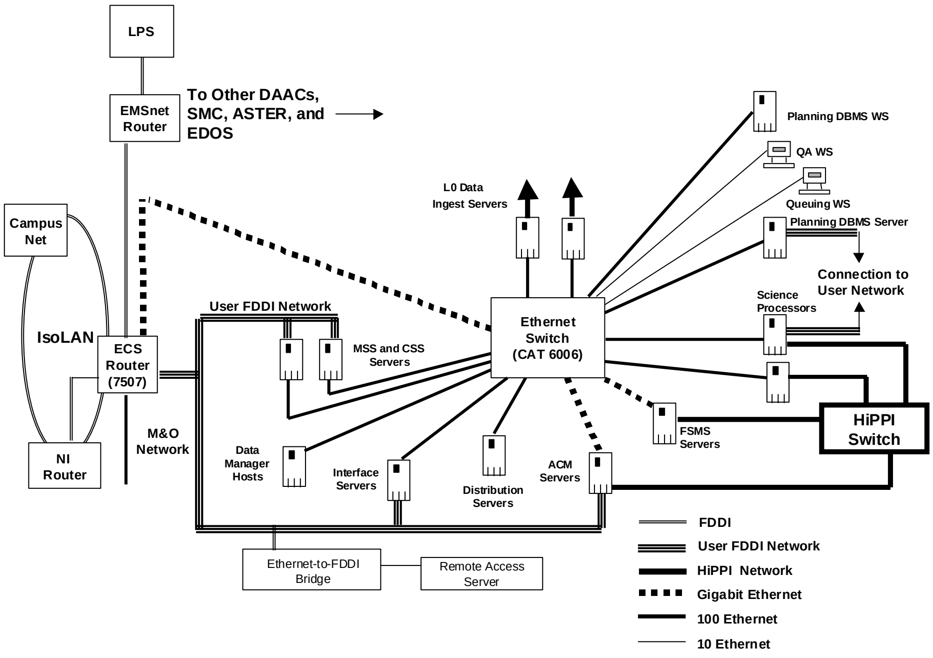

Figure 1. EDC DAAC LAN Topology

[1] The detailed network topology for each DAAC is not presented in the student guide due to network security concerns. However, the details will be discussed during the class presentation.

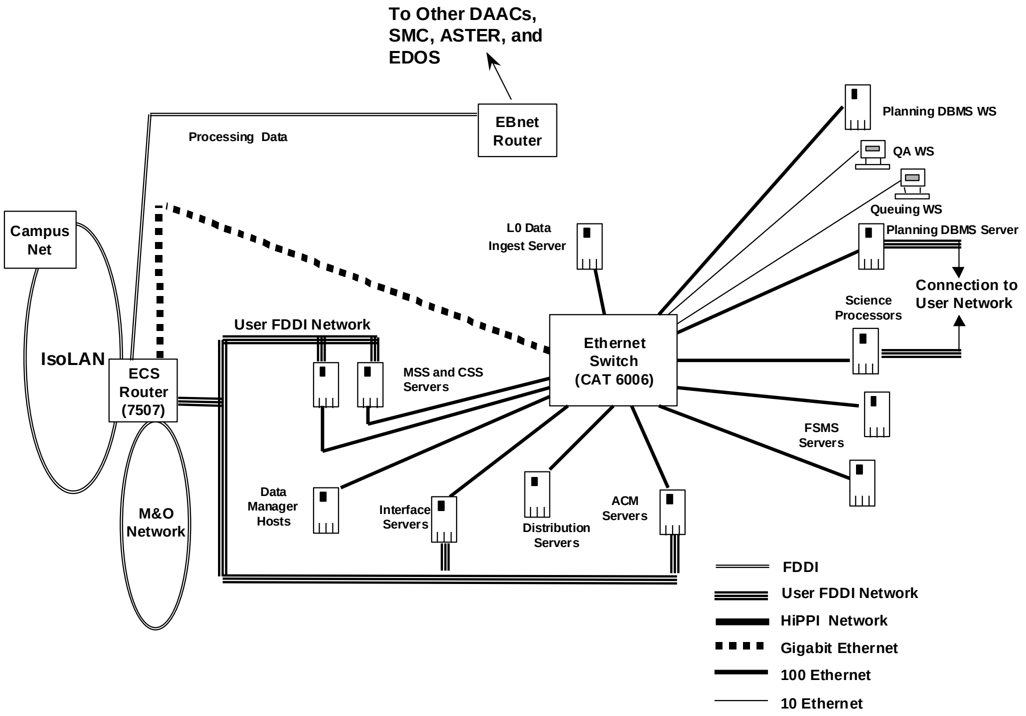

Figure 2. NSIDC DAAC LAN Topology

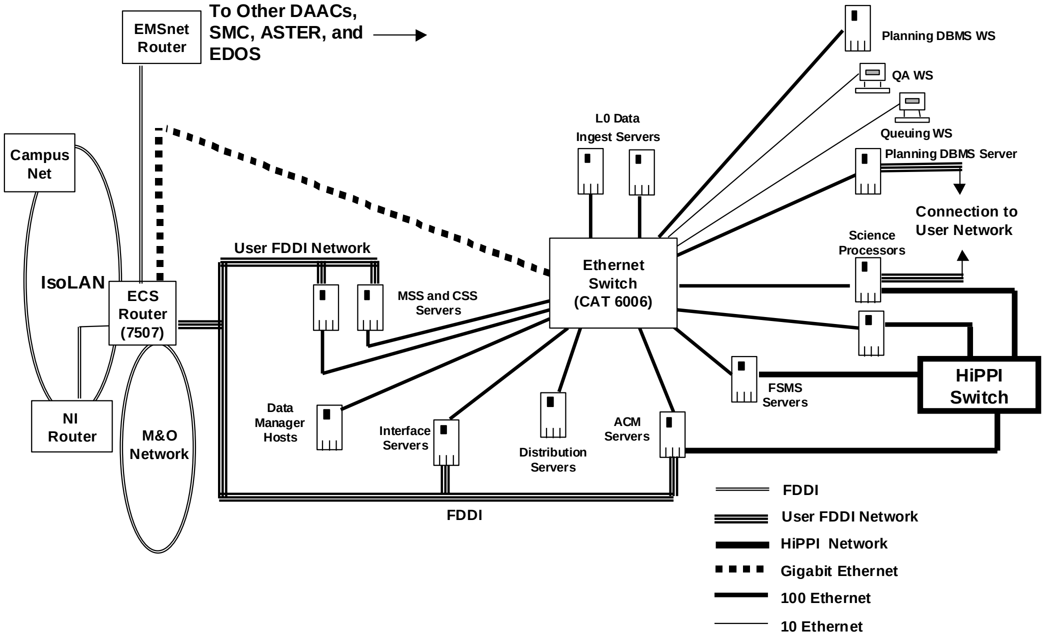

Figure 3. LaRC DAAC LAN Topology

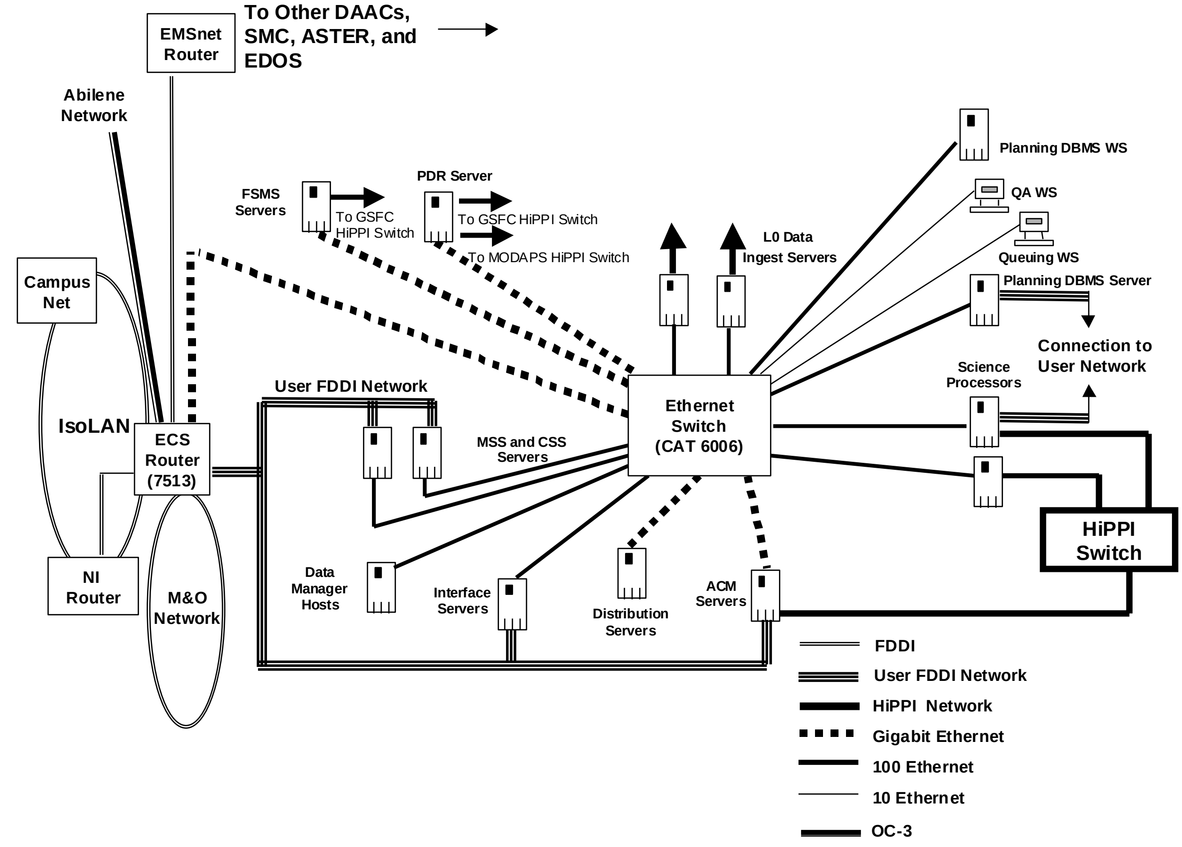

Figure 4. GSFC DAAC LAN Topology

The Production Network

The Production Network consists of a Catalyst 6006 Ethernet switch supporting the DAAC subsystems. EOS Mission Support network (EMSn) [formerly EOSDIS Backbone Network (Ebnet)] connections to external production systems such as EDOS and other ECS DAACs are made by means of the DAAC's ECS router. A connection in the ECS router provides access to the EMSn router to handle DAAC-DAAC flows.

The User Network

The User Network is an FDDI-based LAN connecting users (via NI, local campuses, Abilene, general Internet, etc.) to DAAC hosts responsible for providing user access. It has the main advantage of separating user and production flows. This allows DAAC processing data flows to be unaffected by user demand so that even unanticipated user pull will not hinder the production network. The User Network provides access to Data Manager hosts and to a subset of DataServer hosts that interact directly with users. Users will not have access to any other hosts such as Ingest or Processing devices. CSS and MSS servers are also connected to the User Network. These servers are required for communications with outside networks for such things as name lookups and receipt of Internet mail as well as communication with and monitoring of the DAAC's interfaces to the user community (such as NI and the local campus).

The following subsystems have servers attached to the User Network:

1. Planning Server
2. Science Processor (1)
3. MSS Servers
4. CSS Servers
5. Interface Servers
6. APC Servers

At EDC, there is also an Access Server attached to the User Network. This access server has two 28.8 Kbps modems attached so that remote users can accesses the EDC DAAC User Network by means of a dial-up circuit as well as the Internet.

The User Network connects to the Campus Isolation LAN through an ECS router, which will provide the necessary routing and filtering controls. NI, the local Campus, and other Internet providers will also be connected to the Campus Isolation LAN. At some DAACs, there is an additional direct FDDI connection to the NSI router because of the expected large user data flows.

Ethernet Topology

All hosts within a DAAC are connected to the Catalyst 6006 Ethernet switch. This switch is used to connect hosts at 10/100/100 Mb/s. The Catalyst 6006 Ethernet switch is also connected to the ECS router via a 1000Mb/s circuit.

FDDI Topology

User Network host interfaces have FDDI interface cards, which will be connected to a FDDI concentrator. This FDDI concentrator will be connected to the ECS Router.

The HiPPI Network

The HiPPI Network interconnects Data Server hosts and science processors in order to provide a high-speed network to handle the large data transfers between the two subsystems. The HiPPI network will be implemented via a central HiPPI switch with switched 800 Mbps interface ports connected directly to the high-powered processing and storage hosts. The HiPPI Network shifts the numerous transfers of large volumes of data onto a dedicated high-speed topology, freeing the Ethernet-based Production Network to handle control flows and DAAC-DAAC processing flows.

Network Hardware Components

LAN Components

The DAAC LANs consist of the following hardware components:

FDDI Concentrator. The FDDI Concentrator is a SynOptics 2914. It is a high-speed interface (100 Mbps). It consist of an FDDI interface for connecting to a FDDI ring and 12 FDDI ports for connecting to FDDI based hosts. It is only used on the User network.

Ethernet-to-FDDI Hub. The Ethernet-to-FDDI hub is a Cabletron MicroMAAC-22E. It consist of an FDDI interface for connecting to a FDDI ring and either 12 or 24 shared Ethernet ports It is only used at EDC to connect the access server to the User network.

Access Server. The Access Server is a Cisco 2509. It consist of eight modem ports and an Ethernet port.

Maintenance and configuration of the access server is considered a non-trivial function. Such tasks are addressed in special technical training provided by the vendor and supplemental training provided by ECS. No further discussion of this device will be presented in this course.

ECS Router. The ECS Router is a Cisco 7507 or 7513. It is a high-speed interface (1000 Mbps). It consists of several FDDI and Ethernet interfaces. It interfaces to EMSnet, the local campus network, NI, M&O network, User network, and Production network. It provides IP address and port level filtering in support of the ECS security policy.

Maintenance and configuration of the ECS router is considered a non-trivial function. Such tasks are addressed in special technical training provided by the vendor and supplemental training provided by ECS. No further discussion of this device is presented in this course.

Ethernet Switch. The Ethernet switch is a Cisco catalyst 6006. It provides a large number of 10/100/100Mb/s interfaces. It interfaces to all Production hosts and to the ECS router. Maintenance and configuration of the Ethernet Switch is considered a non-trivial function. Such tasks are addressed in special technical training provided by the vendor and supplemental training provided by ECS. No further discussion of this device will be presented in this course.

HiPPI Switch. The HiPPI Switch is an Essential Communication EPS-16. It is a very high-speed interface (800 Mbps). It is used to connect some of the SGI hosts to a high speed switching fabric.

Note: The NSIDC DAAC does not have a HiPPI Switch.

Maintenance and configuration of the HiPPI Switch is considered a non-trivial function. Such tasks are addressed in special technical training provided by the vendor and supplemental training provided by ECS. No further discussion of this device will be presented in this course.

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ECS Domain Name Services (DNS) Structure

The parent DNS domain for ECS is ecs.nasa.gov. These DNS servers reside at the SMC, NSIDC, and EDC. In this domain are the SMC hosts, User hosts for all DAACs, and pointers to the DAACs' DNS servers.

The ecs.nasa.gov DNS servers are:

- m0mss02.ecs.NASA.GOV (internet address = 198.118.212.37).
- m0mss04.ecs.NASA.GOV (internet address = 198.118.212.41).
- n0css02u.ecs.NASA.GOV (internet address = 198.118.206.84).
- e0css02u.ecs.NASA.GOV (internet address = 198.118.203.104).

The DAACs' Production and HiPPI networks are a child domain of ecs.nasa.gov. They are:

- LaRC Production and HiPPI networks:
  - – l0ins02.larcb.ecs.nasa.gov (internet address = 198.118.219.74).
  - – l0css02.larcb.ecs.nasa.gov (internet address = 198.118.219.67).
- EDC Production and HiPPI networks:
  - – e0ins02.edcb.ecs.nasa.gov (internet address = 198.118.202.159).
  - – e0css02.edcb.ecs.nasa.gov (internet address = 198.118.202.132).
- NSIDC Production network:
  - – n0ins02.nsidcb.ecs.nasa.gov (internet address = 198.118.205.145).
  - – n0css02.nsidcb.ecs.nasa.gov (internet address = 198.118.205.123).
- GSFC Production and HiPPI networks:
  - – g0ins02.gsfcb.ecs.nasa.gov (internet address = 198.118.210.69).
  - – g0css02.gsfcb.ecs.nasa.gov (internet address = 198.118.210.63).

The DAACs' M&O networks are also a child domain of ecs.nasa.gov. They are:

- LaRC M&O network: larcmo.ecs.nasa.gov
- EDC M&O network: edcmo.ecs.nasa.gov
- NSIDC M&O network: nsidcmo.ecs.nasa.gov
- GSFC M&O network: gsfcmo.ecs.nasa.gov

Host Names

Because some hosts are attached to multiple networks (e.g., Production, User, and HiPPI), a letter is appended to the production host name to distinguish which interface (and IP address) a user is accessing.

As an example, a GSFC DAAC host named g0acg01.gsfcb.ecs.nasa.gov is a host attached to the Production network. If that host was also attached to the HiPPI network, it would also be known as g0acg01h.gsfcb.ecs.nasa.gov. If this host were also attached to the User network, it would also be known as g0acg01u.ecs.nasa.gov.

Network Security

ECS Network Connectivity

The ECS network was designed to minimize unauthorized user access. Ingest network access at a DAAC is limited to its Level 0 data provider(s), the SMC, and hosts attached to the DAAC's Production and M&O networks. No local campus, Internet or other DAAC access is provided. Access to a DAAC's Production network is limited to the SMC, the DAAC's M&O network, and other DAACs. No local campus, Internet, or Level 0 data provider(s) access is provided. The ECS Network Connectivity matrix, shown in Table 1, summarizes which networks can access hosts on another network.

Table 1. ECS Network connectivity.

Network	GSFC Prod/ Ingest	GSFC User	LaRC Prod/ Ingest	LaRC User	EDC Prod/ Ingest	EDC User	NSIDC Prod/ Ingest	NSIDC User	VATC Prod/ Ingest	VATC User	PVC Prod/ Ingest	PVC User	SMC	NI/ Internet
GSFC Production/ Ingest	X		X		X		X		X		X		X	
GSFC User													X	X
LaRC Production/ Ingest	X		X		X		X		X		X		X	
LaRC User													X	X
EDC Production/ Ingest	X		X		X		X		X		X		X	
EDC User													X	X
NSIDC Production/ Ingest	X		X		X		X		X		X		X	
NSIDC User													X	X
VATC Production/ Ingest	X		X		X		X		X		X		X	
VATC User													X	X
PVC Production/ Ingest	X		X		X		X		X		X		X	
PVC User													X	X
SMC	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NI/Internet		X		X		X		X		X	X	X	X	

Troubleshooting - Verifying connectivity

One of the key reasons for failure of data access and transfer is an error or problem in system connectivity. This can be caused by a myriad of glitches such as incorrect/outdated lookup tables, incorrectly assigned IP addresses, missing default route and more. Besides checking individual host/server operation with various tools such as ECS Assistant, you can use several command line entries to verify point-to-point communication between components.

There are three initial steps to help verify system connectivity. They include ensuring connectivity is authorized, determining if the Domain Name Service (DNS) is resolving host name and IP addresses correctly, and actively testing the connectivity by using the ping function. Authorized connectivity can be determined by checking the ECS Network Connectivity matrix.

Checking local host access to another local host over the network

1 On workstation ***x0xxx##,*** at the UNIX prompt in a terminal window, check the Domain Name Service entries (DNS) for the source host by typing **nslookup < local_host>**.

- The screen display will be similar to the following:

```
g0spg01{mblument}[204]->nslookup g0spg01
Server:  g0css02.gsfcb.ecs.nasa.gov
Address:  198.118.210.63
 Name:    g0spg01.gsfcb.ecs.nasa.gov
Address:  198.118.210.16
```

2 Check the DNS entries for the remote host by typing **nslookup <other host>**.

- The screen display will be similar to the following:

```
g0spg01{mblument}[201]->nslookup g0css02
Server:  g0css02.gsfcb.ecs.nasa.gov
Address:  198.118.210.63
 Name:    g0css02.gsfcb.ecs.nasa.gov
Address:  198.118.210.63
```

3 Determine the host’s network interface using **ifconfig <interface>** where **<interface>** parameter can be found by executing **netstat -i**

- The **netstat -i** command will provide the following information:

```
g0spg01{mblument}[201]->netstat -i
Name Mtu   Network      Address           Ipkts Ierrs    Opkts Oerrs  Coll
ipg0 4352  198.118.210 g0spg01.gsfcb.   9182666     1  8103032     0     0
hip0 65280 192.168.1   g0spg01h.gsfcb.  5554524     0  6776651     0     0
xpi0 4352  198.118.212.64 g0spg01u.ecs.   37850320     0 14109683     3     0
xpi1 0     none         none                  0     0        0     0     0
et0* 1500  none         none                  0     0        0     0     0
lo0  8304  loopback    localhost        314800     0   314800     0     0
```

- Using **ipg0** from the **ifconfig <interface>** data as the interface parameter, **ifconfig ipg0**, will result in the following display:

```
g0spg01{mblument}[203]->ifconfig ipg0
ipg0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
inet 198.118.210.16 netmask 0xffffff00 broadcast 198.118.210.255
```

4 Ping the two hosts to verify their inter-connectivity.

- Ping the local host (g0spg01).

```
g0spg01{mblument}[232]->ping g0spg01
PING g0spg01.gsfcb.ecs.nasa.gov (198.118.210.16): 56 data bytes
64 bytes from 198.118.210.16: icmp_seq=0 ttl=255 time=0 ms
64 bytes from 198.118.210.16: icmp_seq=1 ttl=255 time=0 ms
64 bytes from 198.118.210.16: icmp_seq=2 ttl=255 time=0 ms
64 bytes from 198.118.210.16: icmp_seq=3 ttl=255 time=0 ms
64 bytes from 198.118.210.16: icmp_seq=4 ttl=255 time=0 ms
 ----g0spg01.gsfcb.ecs.nasa.gov PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
g0spg01{mblument}[233]->
```

- Ping the remote host (g0css02).

```
g0spg01{mblument}[202]->ping g0css02
PING g0css02.gsfcb.ecs.nasa.gov (198.118.210.63): 56 data bytes
64 bytes from 198.118.210.63: icmp_seq=0 ttl=255 time=2 ms
64 bytes from 198.118.210.63: icmp_seq=1 ttl=255 time=1 ms
64 bytes from 198.118.210.63: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 198.118.210.63: icmp_seq=3 ttl=255 time=1 ms
64 bytes from 198.118.210.63: icmp_seq=4 ttl=255 time=1 ms
 ----g0css02.gsfcb.ecs.nasa.gov PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 1/1/2 ms
```

5 Check the health of the interface by executing **netstat -i**, looking for Ierrs and/or Oerrs that, if present (1 or 2 errors are ok, 100 are not ok), indicate an interface problem; check the syslog for any startup or logged problems from the OS.

```
g0spg01{mblument}[218]->netstat -i
Name Mtu   Network     Address              Ipkts        Ierrs      Opkts        Oerrs  Coll
ipg0 4352  198.118.210 g0spg01.gsfcb.       9197317      1          8113487      0      0
hip0 65280 192.168.1   g0spg01h.gsfcb.      5554541      0          6776668      0      0
xpi0 4352  198.118.212.64 g0spg01u.ecs.     37851779     0          14109837     3      0
xpi1 0     none             none            0            0          0            0      0
et0* 1500  none             none            0            0          0            0      0
lo0  8304  loopback    localhost            325510       0          325510       0      0
```

6 Check the routing table for accuracy and completeness by executing **netstat -rn**.

- The resultant display will be similar to the following:

```
g0spg01{mblument}[226]->netstat -rn
Routing tables
 Internet:
Destination     Gateway            Netmask     Flags    Refs     Use  Interface
default        198.118.212.65              UGS       1    14060556  xpi0
127.0.0.1       127.0.0.1                  UH       7    270097     lo0
192.168.1       192.168.1.1   0xffffff00 U          0       0         hip0
192.168.1.1      192.168.1.1               UGHS     0      22         hip0
192.168.1.2      192.168.1.2               UGHS     1     3993577   hip0
192.168.1.3      192.168.1.3               UGHS     0       17        hip0
192.168.1.4      192.168.1.4               UGHS     0     2397593  hip0
192.168.1.5      192.168.1.5               UGHS     2       178       hip0
192.168.1.6      192.168.1.6               UGHS     0         24      hip0
192.168.1.7      192.168.1.7               UGHS       0     1403   hip0
192.168.1.8      192.168.1.8               UGHS       0       6    hip0
192.168.1.9      192.168.1.9               UGHS       0       0    hip0
192.168.1.10     192.168.1.10              UGHS       0       0    hip0
```

```
198.118.198      198.118.210.1  0xffffff00 UGS       0       16    ipg0
198.118.198.12   198.118.210.2            UGHD       0   31646  ipg0
198.118.198.14   198.118.210.2            UGHD       0    1032  ipg0
198.118.198.17   198.118.210.2            UGHD       0       0   ipg0
198.118.198.25   198.118.210.2            UGHD       0     194   ipg0
198.118.198.26   198.118.210.2            UGHD       0   36153 ipg0
198.118.198.27   198.118.210.2            UGHD       0   23425 ipg0
198.118.198.28   198.118.210.2            UGHD       4   11686 ipg0
198.118.198.29   198.118.210.2            UGHD       0    1682  ipg0
198.118.198.30   198.118.210.2            UGHD       3   14760 ipg0
198.118.198.32   198.118.210.2            UGHD       2  917384 ipg0
198.118.198.42   198.118.210.2            UGHD       0   87381 ipg0
198.118.198.76   198.118.210.2            UGHD       3  568062 ipg0
198.118.198.100  198.118.210.2            UGHD       0    1223 ipg0
198.118.198.107  198.118.210.2            UGHD       0     299  ipg0
198.118.198.113  198.118.210.2            UGHD       0     893  ipg0
198.118.198.116  198.118.210.2            UGHD       0    9438 ipg0
198.118.202      198.118.210.1  0xffffff00 UGS       0       0   ipg0
198.118.205      198.118.210.1  0xffffff00 UGS       0       0   ipg0
198.118.208      198.118.210.1  0xffffff00 UGS       0       0   ipg0
198.118.210      198.118.210.16  0xffffff00 U      177  5624292  ipg0
198.118.210.16   127.0.0.1                UGHS      15   55462  lo0
198.118.211.32   198.118.210.1  0xffffffe0 UGS       0    6842  ipg0
198.118.212.32   198.118.210.1  0xffffffe0 UGS       0    1004  ipg0
198.118.212.40   198.118.210.2            UGHD       0    6205  ipg0
198.118.212.64   198.118.212.69 0xffffffe0 U         0    4485  xpi0
198.118.212.160  198.118.210.1  0xffffffe0 UGS       0       0   ipg0
198.118.219      198.118.210.1     0xffffff00 UGS    0       0   ipg0
198.118.220      198.118.210.1     0xffffff00 UGS    0       0   ipg0
198.118.232      198.118.210.1     0xffffff00 UGS    0     143  ipg0
210.138.100      198.118.210.1     0xffffff00 UGS    0       0   ipg0
224            198.118.210.16     0xf0000000 US      0       2   ipg0
g0spg01{mblument}[227]->
```

- Ping the default IP address to ensure connectivity to the default route

  ```
  (default: 198.118.212.65)
  g0spg01{mblument}[228]->ping 198.118.212.65
  PING 198.118.212.65 (198.118.212.65): 56 data bytes
  64 bytes from 198.118.212.65: icmp_seq=0 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=1 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=2 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=3 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=4 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=5 ttl=255 time=1 ms
  64 bytes from 198.118.212.65: icmp_seq=6 ttl=255 time=1 ms
   ----198.118.212.65 PING Statistics----
  7 packets transmitted, 7 packets received, 0% packet loss
  round-trip min/avg/max = 1/1/1 ms
  ```

7 Check the other host using the same steps.

8 Check other hosts using the same infrastructure components as the two hosts with the problem.

9 If the host you are trying to communicate with is attached to the Ethernet Hub, make sure that the “Don’t Fragment” bit in the IP header is NOT set on the host which is FDDI attached. The Ethernet Hub does not support MTU discovery so it will not inform the host that the packet is too big. It silently discards the packet. By default, the Sun hosts are improperly configured. Check the file /etc/init.d/inetinit to ensure that the command to reset the “Don’t Fragment” bit is included: **ndd -set /dev/ip ip_path_mtu_discovery 0**

Checking local host access to another local host over the HiPPI Switch

1 On workstation **x0xxx##**, at the UNIX prompt in a terminal window, check the Domain Name Service entries (DNS) for the source host by typing **nslookup <local_host>**.

- The screen display will be similar to the following:

  ```
  g0drg07{mblument}[205]->nslookup g0drg07h
  Server:  g0css02.gsfcb.ecs.nasa.gov
  Address:  198.118.210.63
  Name:    g0drg07h.gsfcb.ecs.nasa.gov
  Address:  192.168.1.6
  ```

2 Check the DNS entries for the remote host by typing **nslookup <other host>**.

- The screen display will be similar to the following:

```
g0drg07{mblument}[203]->nslookup g0spg01h
Server:  g0css02.gsfcb.ecs.nasa.gov
Address:  198.118.210.63
Name:    g0spg01h.gsfcb.ecs.nasa.gov
Address:  192.168.1.1
```

3 Determine the host's network interface using **ifconfig <interface>** where **<interface>** parameter can be found by executing **netstat -i**

- The **netstat -i** command will provide the following information:

```
g0drg07{mblument}[216]->netstat -i
Name   Mtu    Network     Address          Ipkts   Ierrs   Opkts  Oerrs  Coll
ipg0    4352   198.118.210 g0drg07.gsfcb.   114659    0     63268    0      0
hip0   65280   192.168.1    g0drg07h.gsfcb.    85       0      115     24      0
et0*    1500      none       none              0        0        0      0      0
lo0     8304     loopback    localhost         10062      0   10062    0      0
g0drg07{mblument}[217]->
```

- Using **hip0** from the **ifconfig <interface>** data as the interface parameter, **ifconfig hip0**, will result in the following display:

```
g0drg07{mblument}[217]->ifconfig hip0
hip0: flags=1061<UP,NOTRAILERS,RUNNING,CKSUM>
        inet 192.168.1.6 netmask 0xffffff00
g0drg07{mblument}[218]->
```

4 Ping the two hosts and the hip0 interface IP address to verify their inter-connectivity.

- Ping the local host (g0drg07h).

```
g0drg07{mblument}[205]->ping  192.168.1.1
PING 192.168.1.1 (192.168.1.1): 56 data bytes
64 bytes from 192.168.1.1: icmp_seq=0 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=1 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=255 time=1 ms
 ----192.168.1.1 PING Statistics----
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1/1/1 ms
```

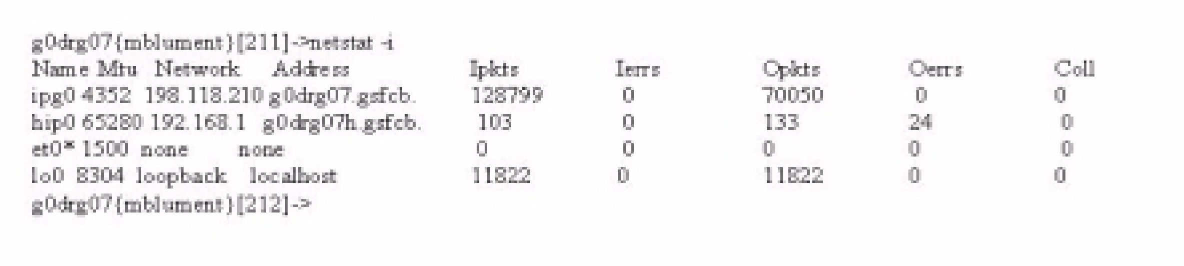
- Ping the remote host (g0spg01h).

```
g0drg07{mblument}[205]->ping  192.168.1.1
PING 192.168.1.1 (192.168.1.1): 56 data bytes
64 bytes from 192.168.1.1: icmp_seq=0 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=1 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=255 time=1 ms
 ----192.168.1.1 PING Statistics----
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1/1/1 ms
```

- Ping the HiPPI switch interface (g0drg07h.gsfcb.ecs.nasa.gov).

```
g0drg07{mblument}[204]->ping 192.168.1.6
PING 192.168.1.6 (192.168.1.6): 56 data bytes
64 bytes from 192.168.1.6: icmp_seq=0 ttl=255 time=1 ms
64 bytes from 192.168.1.6: icmp_seq=1 ttl=255 time=1 ms
64 bytes from 192.168.1.6: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 192.168.1.6: icmp_seq=3 ttl=255 time=1 ms
64 bytes from 192.168.1.6: icmp_seq=4 ttl=255 time=1 ms
64 bytes from 192.168.1.6: icmp_seq=5 ttl=255 time=1 ms
 ----192.168.1.6 PING Statistics----
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max = 1/1/1 ms
g0drg07{mblument}[205]->
```

5 Check the health of the interface by executing **netstat -i**, looking for Ierrs and/or Oerrs that, if present, (1 or 2 errors are ok, 100 are not ok) indicate an interface problem; check the syslog for any startup or logged problems from the OS.



```
g0drg07{mblument}[211]->netstat -i
Name Mtu   Network     Address             Ipkts      Ierrs     Opkts     Oerrs     Coll
ipg0 4352  198.118.210 g0drg07.gsfcb.      128799     0         70050     0         0
hip0 65280 192.168.1   g0drg07h.gsfcb.     103        0         133       24        0
et0* 1500  none        none                0          0         0         0         0
lo0  8304  loopback    localhost           11822      0         11822     0         0
g0drg07{mblument}[212]->
```

6 Check the routing table for accuracy and completeness by executing **netstat -rn**.

- The resultant display will be similar to the following:

```
g0drg07{mblument}[212]->netstat -rn
Routing tables
 Internet:
Destination         Gateway           Netmask    Flags    Refs     Use  Interface
default            198.118.210.1            UGS        2      241         ipg0
127.0.0.1          127.0.0.1                UH         4     4659        lo0
192.168.1           192.168.1.6   0xffffff00 U          0       0          hip0
192.168.1.1         192.168.1.1             UGHS       0       24         hip0
192.168.1.2         192.168.1.2             UGHS       0       24         hip0
192.168.1.3         192.168.1.3             UGHS       0       33         hip0
192.168.1.4         192.168.1.4             UGHS       0        0        hip0
192.168.1.5         192.168.1.5             UGHS       0        0        hip0
192.168.1.6         192.168.1.6             UGHS       0       17         hip0
192.168.1.7         192.168.1.7             UGHS       0       52         hip0
192.168.1.8         192.168.1.8             UGHS       0        0        hip0
192.168.1.9         192.168.1.9             UGHS       0        0        hip0
192.168.1.10         192.168.1.10            UGHS     0        0        hip0
198.118.198.25  198.118.210.2           UGHD     0      612       ipg0
198.118.198.109  198.118.210.2           UGHD     0     7395     ipg0
198.118.210        198.118.210.45  0xffffff00 U     36    64343   ipg0
198.118.210.45  127.0.0.1                  UGHS     21     7892    lo0
198.118.212.40  198.118.210.2            UGHD      0      865    ipg0
224                    198.118.210.45  0xf0000000 US    0       2      ipg0
g0drg07{mblument}[213]->
```

7 Check the other HiPPI attached hosts using the same steps.

8 Check other hosts using the same infrastructure components as the two hosts with the problem.

Checking host communication across EMSn

1 Check the DNS by executing **nslookup < local_host>** and **nslookup <other host>**.

2 Check the host route table using **netstat –r**.

3 Run **traceroute <target host ip address>** or similar tool to discover which router or local route table is in error or not having sufficient route information.

4 Check the Route Advertisement diagram, ECS Connectivity Matrix, and the Network Security Design to see that the filters are not blocking communications or provide no path between hosts. Details are in the configurations of the FDDI switch or ECS router. Also check host TCP Wrappers.

Checking host attached to User Network communicating with Hosts on the Campus Network(s) or to the Internet

1 Check the DNS by executing **nslookup < local_host>** and **nslookup <other host>**.

2 Check the host route table using **netstat -rn**. Make sure that the route_add script has executed correctly. (Note: The route_add script will NOT execute correctly if the User Network interface or Cisco ECS router are not working correctly).

3 Check that the default route is pointing to the Cisco ECS router User Network interface and not pointing to the Production Network interface.

4 Check the Route Advertisement diagram, ECS Connectivity Matrix, and the Network Security Design to see that the filters are not blocking communications or provide no path between hosts. Details are in the configurations of the Ethernet switch or ECS router. Also check host TCP Wrappers.

Checking host communicating with any other host over the HiPPI Switch

1 Check the DNS by executing **nslookup < local_host>** and **nslookup <other host>**.

2 Check on the extent of the problem by pinging itself over the HiPPI interface, ping 192.168.x.x where x.x can be discovered by **netstat -i**. Do the same for other hosts connected to the HiPPI Switch; if all fail, it's a HiPPI switch problem (check the other supplied troubleshooting tip handout); if all other hosts are ok, continue.

3 If the HiPPI cabling has been removed (for example, for SGI maintenance) check for bent pins at the SGI and re-seat cable; if problem not cleared, go to the other troubleshooting tip handout to begin testing with the hiptest testing.

4 Make sure the HiPPI interface is up by executing **hipcntl startup**.

5 Check on the HiPPI interface status by executing **hipcntl hippi0 status** and scan results for error conditions (see SGI ref #1 below, table 3-2).

6 Check that the HiPPI interface is "pingable" by executing **ping <host_ip_address>**; if no response, check the interface for being UP by executing **ifconfig hip0**; if interface is UP, there is probably a cable or switch interface problem.

7 Check the SGI HiPPI interface error counts by executing **netstat –i**.

8 Check for the static routes in the host route table by executing **netstat -rn**. It should look similar to following:

```
192.168.2      192.168.2.5     0xffffff00 U      0      0  hip0
192.168.2.1    192.168.2.1               UGHS    0      9  hip0
192.168.2.2    192.168.2.2               UGHS    0      0  hip0
192.168.2.3    192.168.2.3               UGHS    0    212  hip0
192.168.2.4    192.168.2.4               UGHS    0      0  hip0
192.168.2.5    192.168.2.5               UGHS    0     12  hip0
192.168.2.6    192.168.2.6               UGHS   19     60  hip0
192.168.2.7    192.168.2.7               UGHS    0      7  hip0
192.168.2.8    192.168.2.8               UGHS    0      0  hip0
```

9 Check the HiPPI interface to switch loop by executing **hiptest -I 0x0100000x** where x is the HiPPI switch's port number of the host's connection to it.

10 Check other host interfaces to see if any others are working properly.

11 Check the switch counters by logging (telnet) into the HiPPI switch from a Production network host, and look at counters by executing **show counters all all**. Also check the state of the interfaces by executing **show state all all** and look for interface(s) with a "true" power-up initialization error, a "false" source interconnect, or a "false" destination interconnect.

Specific Security Limitations

In addition to limiting network access as described above, access is further limited by port level filters installed in the ECS router and FDDI Switch. In addition to the port filters, a host's tcp wrappers will further limit network access.

Note: Any service that is not listed below is an allowable service.

The following services are NOT permitted in a DAAC's Production and User networks:

1. Remote login (tcp port 513)
2. Remote shell (tcp port 514)
3. Telnet to hosts (tcp port 23)
4. NFS (udp and tcp ports 2049)
5. Port Mapper [RPC] (udp and tcp ports 111)
6. Access to udp and tcp ports 255-1023 on NIS servers
7. X-11[2] (udp and tcp ports 6000-6003)

Also, ftp is NOT allowed to the MSS and CSS servers from the User network (tcp port 21).

Each DAAC has its own M&O Sustaining Engineering network. Hosts attached to this network are NOT permitted to use the following services when communicating with their Production and Ingest networks:

1. Remote login (tcp port 513)
2. Remote shell TCP port 514)
3. Telnet (tcp port 23)
4. NFS (udp and tcp ports 2049)
5. Port Mapper [RPC] (udp and tcp ports 111)
6. Access to udp and tcp ports 255-1023 on NIS servers

Note: All other services, including X-11 (udp and tcp ports 6000-6003) are permitted.

The Network Security diagram, illustrated in Figure 5, shows graphically the information discussed above.

[2] X-11 is a special case. By default it is not allowed for X servers (X-terminals). However, a DAAC can decide to allow X-11 access between a selected set of hosts within the DAAC and an external entity such as a remote SSI&T host or a host at another DAAC. This access would be granted by modifying the appropriate router filter tables.

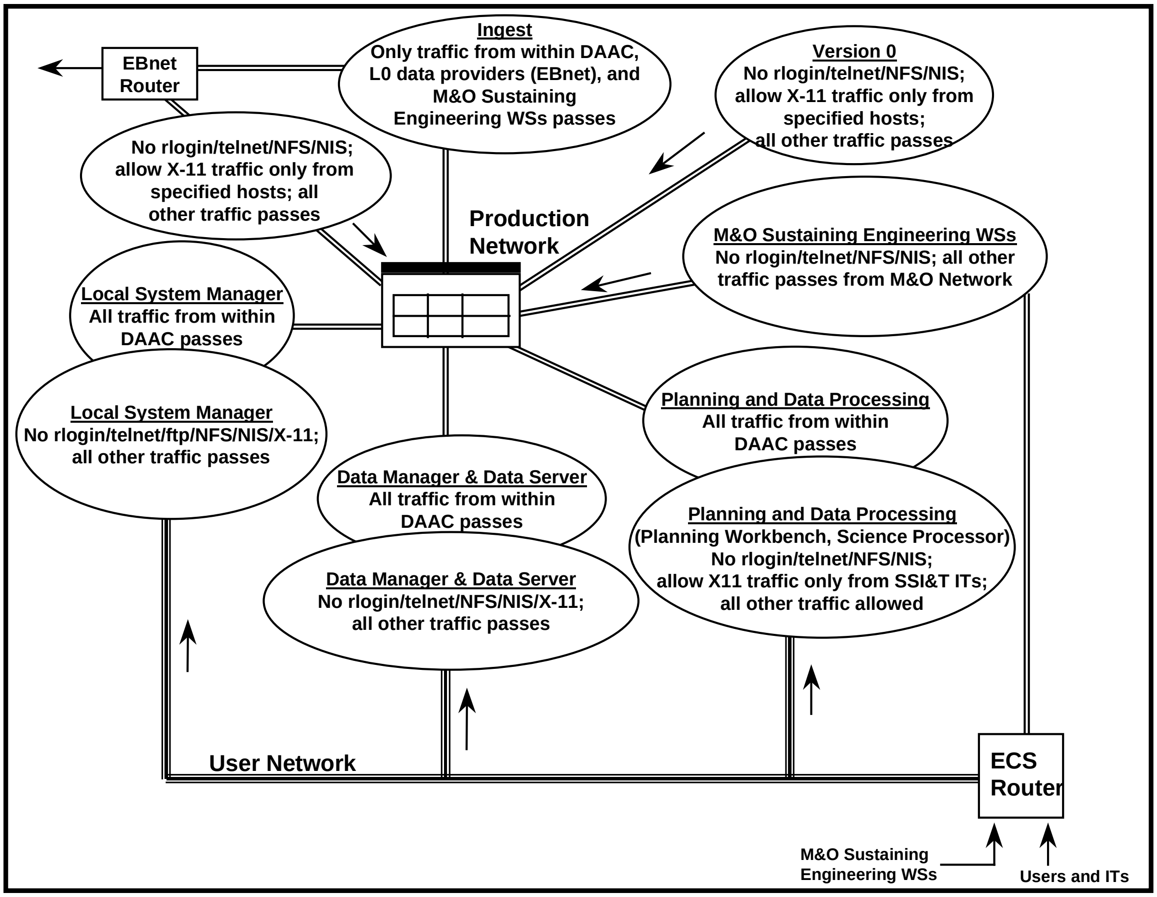

EBnet Router
Ingest
Only traffic from within DAAC, L0 data providers (EBnet), and M&O Sustaining Engineering WSs passes
Version 0
No rlogin/telnet/NFS/NIS; allow X-11 traffic only from specified hosts; all other traffic passes
No rlogin/telnet/NFS/NIS; allow X-11 traffic only from specified hosts; all other traffic passes
Production Network
M&O Sustaining Engineering WSs
No rlogin/telnet/NFS/NIS; all other traffic passes from M&O Network
Local System Manager
All traffic from within DAAC passes
Local System Manager
No rlogin/telnet/ftp/NFS/NIS/X-11; all other traffic passes
Planning and Data Processing
All traffic from within DAAC passes
Data Manager & Data Server
All traffic from within DAAC passes
Planning and Data Processing
(Planning Workbench, Science Processor)
No rlogin/telnet/NFS/NIS; allow X11 traffic only from SSI&T ITs; all other traffic allowed
Data Manager & Data Server
No rlogin/telnet/NFS/NIS/X-11; all other traffic passes
User Network
ECS Router
M&O Sustaining Engineering WSs
Users and ITs

Figure 5. Network Security

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Route Add Scripts

On each host which is attached to both the Production and User networks, special route add scripts are run at system startup to add several static routes to the host's routing table.[3]

Script Locations

There is a separate route add script for each host type (Sun, SGI, and HP). The scripts are located in the following directories:

- Sun: script S87route_add is in directory /etc/rc2.d
- SGI: script S87route_add is in directory /etc/init.d with a soft link to /etc/rc2.d/S87route_add

[3] The details of the host's route tables for each DAAC are not presented in the student guide due to network security concerns. However, the details will be presented during the class presentation.

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Practical Exercises

Introduction

These exercises are designed to practice key elements of the Network Administration procedures. Perform the tasks identified in each set of exercises.

Equipment and Materials

611-CD-610-001 *Mission Operation Procedures for the ECS Project*.

609-CD-610-002 *Release 6B Operations Tools Manual for the ECS Project*.

A functioning ECS system.

Describe Network Topology

1. Make a rough sketch of the topology of the network at your site; include the major elements of the network and show their relationship.
2. List the major hardware elements that make up the network at your site.

Perform Activities Related to Network Monitoring and Management

1. Conduct a check of local host access to another local host over your network.
2. Conduct a check of local host access to another local host over the HiPPI switch.
3. Conduct a check of host communication across the EMSn.
4. Conduct a check of a host attached to User Network communicating with Hosts on the Campus Network(s) or to the Internet.
5. Conduct a check of a host communicating with any other host over the HiPPI Switch.

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Slide Presentation

Slide Presentation Description

The following slide presentation represents the slides used by the instructor during the conduct of this lesson.

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